

study that world from the insect standpoint as its center, to realize as clearly as we can, by insight and imagination, what it would be to a beetle or a butterfly, a caterpillar or a grub, if it were endowed with our capacities of observation, analysis and inference; how and to what ends and by what means it would act upon that world and how and by what means its world would react upon it in turn; and what has been the history of the system of actions and reactions through the agency of which it has become what it finds itself to be. Except as we can approximate this ideal—in so far, that is, as we adhere in our studies to the merely human point of view—our perspectives must be distorted and our emphases wrongly placed, to the confusion and disappointment of our efforts to solve the intricate problems of insect life.

THE EXTERNAL ANATOMY OF ANTHOMYIA RADICUM Linn.*

(Diptera, Anthomyidæ).

By HOWARD L. SEAMANS.

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The North American Anthomyidæ, though belonging to one of the largest and most important of the families of the Diptera, are nevertheless in very unsatisfactory condition from the systematic standpoint. The permanent work that has been accomplished on these flies has been concerned largely with the economic relationships of individual species, and, in this country at least, very little thorough work along taxonomic or morphological lines has been done. It is apparent that there is a real opportunity for systematic work in this group, and, as a preliminary step in this direction, the writer undertook a morphological study of *Anthomyia radicum* Linnæus, one of our most common species in this family, and this paper gives the results of this study.

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Specimens for study were first softened in a solution of alcohol, glycerine and formalin. For the study of the wings and legs these parts were removed from softened specimens and placed in 70 per cent alcohol, then in carbolic acid-turpentine clearing solution, and finally mounted in Canada balsam. For the study of the body parts bearing sclerites and sutures it was usually necessary to cut away the parts with a sharp scalpel, boil in a 5 per cent solution of potassium hydroxide to remove non-chitinous tissue, preparatory to mounting in balsam. The head capsule was prepared in the same manner and mounted whole in balsam, in a xylonite ring. Treated in this manner the parts under study retained their normal form, while the bristles, sclerites and regions could be distinctly seen.

Some specimens were placed in chlorine water until they had been bleached to a light yellow and were almost transparent. These were then washed, dehydrated and placed in thin balsam until they were completely filled with the medium. Whole mounts were made in xylonite rings and studied for the various structures.

Drawings were made from prepared slides with the aid of apparatus consisting of a small arc lamp the light of which was directed through the barrel of a microscope placed horizontally with a mirror attached so as to present a surface to the ocular at 45°. When a slide was placed on the stage of the microscope the image was projected on a paper under the mirror on the table where it could be traced.

ANATOMICAL STRUCTURE.

The terms used in designating special sclerites, sutures or regions are for the most part those recognized by Dr. Crampton of the Massachusetts Agricultural College. In some instances terminology has been taken from Lowne, or other authentic sources, but since the terms are in common usage, they should cause no confusion.

THE HEAD.

The outline of the head when viewed from the front (Figs. 1 and 2) is nearly circular, being slightly wider than high, and less regular in the female than in the male. Viewed in profile the outlines differ greatly in the two sexes. In the female (Fig. 3) the line from the vertex to the base of the antennæ is almost at right angles to the line from the vertex to the occipital foramen. The face is almost perpendicular, having a slight tendency to be retreating. The antennæ are situated distinctly above the middle and are about one-third as long as the major axis of the head. In the male head (Fig. 4) the vertical angle is decidedly acute, the antennæ are situated at about half way down from the vertex, the face is retreating, making the epistome appear to protrude, and the minor axis is only two-thirds the length of the major axis. The posterior aspect of the head is essentially the same in both sexes, showing distinct sclerites and sutures, while the anterior portion shows regions which are variable in the two sexes. There are five sutures arising from points on the occipital foramen (Fig. 7). Two of these arise from the two dorsal angles of the foramen, two from the two ventral angles, and one from the middle of the dorsal margin. The two sutures arising from the dorsal angles of the foramen are the paracephalic sutures of Lowne (prsu). These extend upward to the vertex and then around the compound eyes. The two lateral halves of the head thus formed are the paracephala (prc) (Fig. 7).

The suture which arises from the middle of the dorsal margin of the occipital foramen extends about one-third the distance towards the vertex and forks, each fork disappearing in a faint, almost indistinguishable suture which turns downward at an acute angle to meet the foramen at the base of the paracephalic sutures. The two triangular areas thus formed are the epioccipital sclerites of Lowne (epos). The space between the paracephalic sutures and above the epioccipital sclerites is the epicephalon (epc).

The two sutures which start from the ventral angles of the foramen are the basal sutures (bsu). These extend downward, meeting a fold just above the oral margin, and become indistinct. The somewhat irregular six-sided area cut off from the paracephala by these sutures is the metacephalon (mtc). The

vestiture of the occiput shows more or less distinct regions of which one is very clearly defined. This is a region just back of the compound eyes, the posterior eye orbit, set off from the rest by a row of more prominent hairs (Figs. 3, 4 and 7). There is a small patch of fine bristles at the base of each epioccipital sclerite, while the epicephalon is bare, except for the post vertical bristles. The metacephalon is divided into two lateral regions by the vestiture, leaving a groove in the center practically bare.

Viewing the head from the front (Figs. 1 and 2) the most striking difference between the sexes is in the compound eyes. Those of the male are very large, being practically contiguous for a short distance, while in the female they are smaller and widely separated. The antennæ of the female are located higher up than are those of the male, and the vertical bristles are much larger. Except for a considerable narrowing in the male the regions in both sexes are homologous. The male head bears more bristles than the female but they are weaker and less prominent.

At the extreme vertex of the head in both sexes there is a heavily chitinized, slightly raised, almost equilateral triangle, with its apex directed towards the base of the antennæ. This is the ocellar triangle (ot) and it bears a simple eye in each corner. It bears three or four pairs of stout short bristles, the posterior ones upright, and the anterior ones directed forward. Below the ocellar triangle and above the base of the antennæ is a region known as the front. In the males this is a triangle with the apex directed upward and is known as the frontal triangle (ft.) (Fig. 2). In the females the front (f) is broad, somewhat rectangular, bears a pair of bristles located just below the ocellar triangle, and directed forward, the cruciate bristles. In the male these two bristles are located very close together at the apex of the frontal triangle.

The vertex in the female bears two pairs of large vertical cephalic bristles, the inner pair convergent and the outer pair divergent. Behind the ocellar triangle is a pair of divergent post vertical bristles.

On each side of the front, bordering the compound eyes, is a narrow region which reaches from the vertex to the base of the antennæ, where it is cut off by an oblique division line. These two areas are the parafrontal plates (prf) bearing eight pairs of

bristles in the female, and ten in the male, the fronto-orbital bristles (fobr). Below the parafrontal plates are narrow regions which follow the orbit posteriorly. These regions are the genæ (g) and bear no bristles or spines (Figs. 1, 2, 3, 4), but are sometimes pubescent.

At the base of the front and just above the base of the antennæ, is a triangular opening lunule (l) through which an eversible sac, the ptilinum, protrudes when the insect is emerging from the pupa. From this opening a suture extends downward on each side, ending just below the tip of the third joint of the antennæ. The eversible sac extends the entire length of the suture. This suture is the frontal suture (fsu) of Lowne, and a slight line of demarkation extends from the tip of the suture to the oral margin. The lower margin of the lunule is formed by the upper margin of the sclerite which bears the antennæ. (Fig. 5). The sclerite is cut off from the head capsule by a suture, for the most part concealed by the antennæ. This suture, however, follows the vibrissal ridge, below the antennæ, and then encircles the oral margin. The sclerite shows distinct regions including the epistome, though no bristles are present, and corresponds closely to the face, as that term is used by Lowne. However, Lowne includes in his term face all the area surrounded by the frontal suture. The area which Lowne considers the facialia or facial edge of the paracephalon is the region which in this species lies between the face and the frontal suture and bears the oral vibrissæ and facial bristles. (Figs. 1, 2, 3 and 4).

Between the genæ and facialia is a somewhat flattened, triangular area extending from the oral margin to the eye border. This is the transverse impression or bucca (bu) and in both sexes is devoid of bristles or hairs, but is somewhat pollenous. (Figs. 1, 2, 3 and 4). Bounding the bucca posteriorly and extending towards the occiput and along the oral margin is a distinctly raised or convex region, which is the cheek (c). This is covered with long black hairs and has a row of distinct bristles along the oral margin. (Fig. 1, 2, 3, 4).

The antennæ present no distinct sexual differences. (Fig. 6). They are three jointed, the third joint bearing a long, slender, pubescent, three-jointed arista (ar). The first joint of the antenna is the smallest, short, collar-like and slightly compressed laterally. There are two bristles on the anterior

surface. This joint appears to be immovably attached to the head. The second joint is longer, attached to the first by a movable joining, and bears a coronet of bristles on its anterior surface. The third joint is the largest, being twice as long as the second, somewhat broader, and laterally compressed. It is attached to the second joint by an immovable attachment formed by parts fitting together like saw teeth. In addition to the three jointed arista, this joint bears structures which are apparently sense organs, consisting of openings leading to small internal cavities. Each such opening is protected by a ring of bristles pointing outward towards a common center. This joint also appears to be porous and sponge-like, the pores being much smaller than the openings to the sense organs. All three points are covered with short, fine pubescence.

The arista (Fig. 8) is three jointed, all the joints movable, and pubescent. The first two joints are short, cylindrical, the second about twice as long as the first. The third joint is long, somewhat larger at the base and for the basal third, tapering from there to a fine hair-like point. The spines appear to be different from ordinary spines and may function as sensory hairs.

The discussion of the mouth parts will be left for a later publication as they appear to show no characters of value to this work, but do show some interesting anatomical features that need further study.

THE THORAX.

Of the thoracic segments, the first and last are greatly reduced, the mesothorax forming the greater part of the whole. The dorsum of the thorax, with the exception of the two anterior swellings, is the mesonotum. The two anterior swellings or the humeral callosities (hcly) are the upper portions of the pronotum. (Figs. 10 and 12). Anterior to the base of the wings a suture crosses the mesonotum, the transverse suture (trsu), which separates the anterior region or prasecutum (prs) from a posterior region, the scutum (sc). Above the halteres another suture crosses the mesonotum separating the scutum from a posterior, somewhat triangular region, the scutellum (scl). (Figs. 9 and 12). The mesonotum bears two distinct rows of large, strong bristles which diverge slightly posteriorly (Fig. 9). Each row consists of five bristles arranged two on

the praescutum, and three on the scutum. These are the dorsocentral bristles, those on the praescutum being the anterior dorsocentrals, and those on the scutum being the posterior dorsocentrals. Between the rows of dorsocentral bristles are two rows of setæ, never very symmetrical, variable in number, starting with two strong bristles on the praescutum and ending in two strong bristles at the posterior end of the scutum. These are the acrostichal bristles (acr). Two strong bristles are present on the humeral callosities, which are known as the humeral bristles (hb). (Figs. 9, 10 and 12). On each side of the praescutum, close to the humeral callosities, is located a strong bristle, the posthumeral bristle (phm.) Near the posterior angle of the praescutum there is a strong bristle, the praesutural bristle (prsl). On the sides of the praescutum, next to the notopleural suture there are two strong bristles, the notopleural bristles (npl). (Fig. 12).

In addition to the bristles mentioned above, the scutum bears two bristles outside of each row of dorsocentral bristles, the intra-alar bristles (ial). Below and somewhat anterior to the intra-alar bristles, on the sides of the scutum, are located the supra-alar bristles (sal). In some of the Anthomyidae there are three supra-alar bristles, the anterior one being the "Pro" of Stein. Posterior to these and located on the side and dorsum of the postalar callosities, are the post-alar bristles. (pal).

The bristles of the scutellum are small except for one pair of strong bristles located at the anterior angles of the scutellum, and a pair of still larger ones, located on the posterior border of the apex. This last pair have been called the apical bristles or scutellar apicals (scla).

The prothorax is indistinct when viewed from the side, being represented by three visible sclerites. Of these three, the pronotal lobe, or humeral callosity, is the most conspicuous (Fig. 12). This is an irregularly shaped sclerite somewhat resembling a budding mushroom in general outline. The two humeral bristles (hm) are located on this sclerite, near the dorsal margin. Below this sclerite, and separated from it by a distinct suture, is the proepisternum (pres). This is also irregularly shaped and bears three bristles near its ventral margin, just above the base of the prothoracic coxa. Anterior to these two sclerites another sclerite can be noticed in a lateral view. This is the prodorsum (pd) of Lowne, but it can be better studied in an anterior view.

The anterior view of the prothorax (Fig. 10) shows the parts before mentioned. The prodorsum forms the dorsal rim of the foramen and an articulation with the head. At the two lower angles of the foramen are triangular sclerites, which have anterior projections. These are the condyles (cnd) of Lowne and also articulate with the head. Between the condyles is a rounded somewhat shield-shaped sclerite, which Lowne has termed the sella (s). This articulates with the lower part of the occipital foramen of the head.

Below the sella and condyles and between the coxa (cx) the prosternum (psn) is seen as a somewhat shield-shaped sclerite, but extends posteriorly to meet the sternopleurite. A study of the pleura of the thorax shows many sclerites and sutures of the other thoracic segments (Fig. 12).

Posterior to the propleura and below the præscutum is a large, irregular-shaped sclerite, the largest of the pleural sclerites, which is separated from the posterior portion of the mesopleura by a strong suture, the pleural suture (plsu). This suture, arising from the base of the wing, extends irregularly to the middle coxæ. The sclerite formed by this suture is made up of the mesoepisternum fused with part of the sternum and propimeron. The sterno pleural suture (ssu) imperfectly divides this sclerite dorso-ventrally, the dorsal portion being the anepisternum (ans) and the ventral portion the sternopleurite (stp). In the upper anterior corner of the anepisternum is located the anterior spiracle (spa) (Figs. 10 and 12). Behind the upper portion of the pleural suture is an irregularly pentagonal sclerite, which has a short suture starting into it from the dorsal border near the wing base. This suture indicates the fusion of two sclerites, the anterior one being the pleural wing process (pwp) and the posterior one the ptero-pleurite (ptp). Below the ptero-pleurite and behind the lower section of the pleural suture is located another irregular five-sided sclerite which is divided by two faint sutures into three parts. The whole sclerite is known as the mero-pleurite and forms the posterior ventral sclerite of the mesothorax. The posterior dorsal sclerite of the mesothorax is located in front of the halteres, and divided into two portions by a slight transverse suture. This sclerite extends to the anterior portion of the scutellum, and is known as the pleurotergite (ptg).

Immediately below the scutellum is an exceedingly convex sclerite, part of the post-scutellum, which extends laterally to the pleurotergite, and is known as the mediotergite (mdtg). Below the mediotergite is a sclerite which bears the halteres, the metanotum (mtn). Back of the meropleurite is a long, slender sclerite in an oblique position, the metaepisternum, which is divided at the upper end by a suture making two divisions in it. Below the metanotum and posterior to the metaepisternum is a sclerite of similar shape, the meta-epimeron (mtem) (Fig. 12). Surrounded by the metaepisternum, the pleurotergite and the meropleurite is the posterior spiracle (spp) (Fig. 17).

There are membranous portions of the thorax near the base of the wings, which allow freedom of movement of parts. There are four small plates or sclerites in this membranous portion, two at the base of the wings, and two posterior and above the ptero-pleurite. The first two are the basal plates (bpl) and the latter are the sub-alar plates (sapl). Above the sub-alar plates is a triangular, more or less distinct, region extending towards the scutellum, known as the juxtascutellum or scutellar bridge. (jscl).

The chaetotaxy of the pleura is similar in both sexes with the exception of the sternopleurite. The anepisternum has four stout bristles near its posterior margin and a more or less covering of hair. In the male, the sternopleurite has one strong bristle below the sternopleural suture, one at the posterior angle of the pleural suture, and one just below the last, also along the pleural suture. (Fig. 12). In the females the last mentioned bristle is wanting. In both sexes the sternopleurite has two (more or less strong) bristles on the anterior surface just above the front coxæ, and is somewhat covered with hair on the posterior portion, which become bristles just in front of the mesocoxæ. The coxal sclerite next to the sternopleurite has a row of four strong bristles.

Each spiracle is surrounded by fine hairs which curve over the openings and serve as a protection or sieve.

THORACIC APPENDAGES.

The wings show no difference of structure in the two sexes. (Fig. 13). The costal vein extends to the tip of the fourth vein, and is weakly pectinate. At the tip of the auxiliary vein, the costa is broken, and a short, weak spine is located at the basal

side of the break. The first vein (v1) ends in the costa at about the center of the anterior margin. The second vein (v2) ends by a short, but distinct, curve forward in the costa near the tip of the wing. The third vein (v3) ends at the tip of the wing with a slight curve forward, while the fourth vein, ends either straight or with a slight convergence from the third vein. The anterior cross (acrv) vein meets the margin of the discal cell (dcl) at the distal third, and almost at right angles to the third vein. The posterior cross vein (pcrv) is oblique, meeting the fifth vein about one-fifth of the distance from the wing margin. The second basal (bcl2) and anal (acl) cells are of equal size and small. The alula (ala) is slightly smaller in the female wing than in the male, but conspicuous in both sexes.

At the base of the costal vein there are two scales (Figs. 13 and 14) which have been called the tegulæ, or epaulets. These lie over the base of the vein, the uppermost one being the tegula or epaulet (ept) and the lower one the sub-tegula or sub-epaulet (sept). These are of some use in the classification of some flies and could probably be used in the Anthomyidæ.

The base of the first vein seems to be in three sections. The first two of these have several small openings (Figs. 13 and 15). According to Lowne, these openings, especially the group on the remigium (rm), or first section of the vein, are the chordonotol organs, the same as are found more highly developed in the haltere. Similar openings are also found on the auxiliary vein, at the tip of the first vein, at the tip of the second vein, at the tip of the fifth vein, and on the anterior cross vein (Fig. 13). The membranous portion of the wing is covered with fine spines as are also the veins. The border of the wing has a short fringe of fine hairs.

The squamæ (Fig. 16) are two membranous scales located at the base of and below the wings. When the wing is pulled forward the two scales are plainly seen, the upper or antisquama (sqa) being the anterior and the squama (sq) or lower one, the posterior scale. In this species the antisquama is larger than the squama and round, while the latter is roughly triangular. There is a fringe of long fine yellow hair on each scale, which seems to arise from a thickened border of the membrane. (Fig. 18).

The halteres or balancers are located on the metanotum and according to Lowne they are highly specialized organs of sense.

Though they appear to be rudimentary wings they are far from being vestigial organs. There are three parts, the scabellum (scm), or base, the scape or stalk (sce), and the head (hd) or the apical end (Fig. 11). The halteres are considered to be auditory organs and they carry a fluid in canals similar to the semi-circular canal of the higher animals, giving them the function of maintaining equilibrium.

The three pairs of legs are similar in structure and show slight sex differences. The main difference, which appears in all the legs, is that the bristles and spines of the male are stronger than those of the female. For the purposes of this paper, the legs will be spoken of as if they were drawn out at right angles to the body (Fig. 30). The surface which is then directed forward will be the anterior surface and opposite to it, the posterior surface. That surface which is above will be the dorsal surface and that opposite, the ventral surface.

In the prothoracic legs (Fig. 30A) the coxa (cx) in both sexes is longer than wide, of a somewhat irregular shape, and equipped with five stout spines on the dorsal or flexor surface. (Fig. 21A). The trochanter is small, somewhat triangular, and has no spines, and only one or two small hairs. (Fig. 24A and B). The femur (fm) of the male differs from that of the female in being strongly bowed. In both sexes this segment tapers slightly towards each end, and is armed with rows of strong spines on the posterior surface, two rows especially on the dorsal and ventral margins of the posterior surface (Fig. 28A). The anterior surface of the femur has a few irregular rows of small hairs. The tibia (ti) is as long as the femur, small at the base and slightly enlarged at the apex. (Fig. 31). In both sexes the tibia is armed with a pre-apical bristle and an apical spur. The tarsi (ts) are five-jointed (Fig. 36), the first being the longest and equipped with a distinct spine at its base and smaller ones below that on the ventral surface. (Fig. 36B). All the tarsal joints are pubescent and each of the first four has a weak apical spur (Fig. 36B). The fifth tarsal joint bears two stout, simple claws (clw), two pulvilli (pv), which are larger in the male than in the female (Fig. 34A and B), and a fine hair-like empodium (emp) (Figs. 35 and 36B and C). The tarsi of all three pairs of legs are similar, having no distinct differences. The pulvilli are membranous and covered with long, fine hairs which arise from conical protuberances on the

surface. (Fig. 36E). The tarsal joints are movable, being rather on the order of a ball and socket joint, the attachment between the first two allowing only limited movement (Fig. 36D), and one like that between the fourth and fifth allowing extreme freedom (Fig. 36F).

The mesothoracic legs (Fig. 30B) are the longest of the legs. The coxa (Fig. 20) is roughly diamond-shaped and flattened in a dorsal view, but as viewed anteriorly it consists of two halves. The dorsal half has four or five stout bristles on the dorsal margin of the anterior surface. The trochanter is roughly triangular with a coronet of hairs near the apex (Fig. 23A and B). The femur (Fig. 27) is long, tapering slightly at either end. There are eight strong bristles on the anterior surface, while the rest of the femur is covered with fine short hairs, except at the apex where there are two bristles. The tibia (Fig. 26) is slender, enlarging at its distal end. It is armed with two or three stout spines on its anterior surface, a pre-apical bristle and an apical spur.

The metathoracic legs (Fig. 30C) are of medium length in the male and as long as the mesothoracic legs in the female. The coxa (Fig. 19) is an irregular-shaped piece with one small, stout bristle on the dorsal surface and a row of small bristles on the distal margin. (Fig. 19B). The trochanter (Fig. 22) is somewhat irregular with a strong bristle on its ventral surface. The femur (Fig. 25) enlarges suddenly at the base and tapers slightly at its distal end. Starting at the base, at the dorsal angle, there is a row of stout bristles which curves irregularly on the anterior surface, ending near the apex. There is a row of five fairly stout bristles on the ventral surface. The tibia tapers slightly at the base and besides three strong bristles on the dorsal surface and two on the anterior and ventral surfaces, each, it is armed with a pre-apical bristle and an apical spur. All parts of the legs with the exception of the coxæ and trochanters are covered with rather coarse pubescence, or fine hairs arranged in more or less regular rows.

THE ABDOMEN.

When viewed dorsally, the abdomen appears to be composed of but four segments in the female and five in the male. There is, however, an imperfect suture which separates the first and second segments dorsally, and a plate which indicates the first segment as being distinct from the second ventrally.

The male abdomen (Figs. 37 and 38) differs from the female abdomen (Figs. 40 and 41) in shape, number of segments and form of the ventral plates. In general shape it is oval, the anterior end produced laterally, the posterior end blunt. It is about twice as long as broad and the segments, with the exception of the first and last, are of about equal widths. The female abdomen is about the same size as that of the male, but more pointed posteriorly, the second and fifth segments being the longest. The genital segments are barely visible in both sexes from above, and what appears to be the sixth segment in the male is the first genital segment. This is more apparent from the ventral view. Spiracles (sp) are visible on all five segments when viewed ventrally.

Ventrally the first segment is indicated by a short, wide ventral plate (vpl) connected to the dorsal sclerite by a membrane, the abdominal pleura. The second segment is produced into a ring at its anterior margin. The third and fourth ventral plates in both sexes are simple, rather long, and narrowed slightly posteriorly in the female, but almost square in the male. The fifth ventral plate (vp5) in the female resembles the third and fourth, but the fifth ventral plate of the male is complicated, being produced posteriorly into two long branches between which the forceps and genitalia lie when extended.

There are two genital segments in the male, the first a convex, somewhat ringlike segment, and the second (Fig. 37) is almost completely divided into two lateral halves with the anal opening (ao) between them. From the apical margin two branches project which are the forceps. The genital organs are found in the two genital segments but mostly in the second. (Fig. 32). At the posterior basal portion of the penis (pns) there is a hooklike process, the posterior clasper (cp) (Fig. 33). Opposite to this on the anterior side is located the anterior clasper (ca).

There is only one genital segment in the female, a small, ring-like segment, with an opening on its ventral surface, which serves as a genital and excretory opening. The genitalia are all internal.

For the most part the abdomen in both sexes is covered with hair, which is shorter and less dense along the median dorsal line. The first segment in the female has no distinct bristles, while the same segment in the male has a few bristles

along the posterior margin. All the rest of the segments have marginal bristles, those at the sides being longer and stronger than those near the median line. The ventral plates have only a few bristles at the margins and a sparse covering of hair towards the center. (Figs. 37 and 40). The first genital segment in the male has several long, strong bristles, while the second has a few along the posterior border. The forceps (fc) each have a distinct spur or tooth near the tip, and are covered with short bristles. The apical point of the second genital segment has two long, weak bristles (Fig. 37). The genital segment in the female has only a few short bristles on the ventral side (Fig. 40).

The chaetotaxy of the abdomen is not constant, and the number of marginal bristles varies with the individual.

SUMMARY.

The head, with the exception of the face, the epicephalon and metacephalon, is apparently all one piece, divided into regions which are constant for both sexes. With the exception of the face, the anterior portion of the head is one piece, divided into distinct regions.

The chaetotaxy of the head is constant for each sex and can be relied upon.

The thoracic sclerites in the two sexes are the same, and are constant.

The bristles of the mesonotum are constant with the exception of the weak acrostichal bristles which vary in number and arrangement.

The males are always equipped with three sternopleural bristles while the females have only two.

The hair covering of the pleural sclerites is the same in both, but not regular.

The third and fourth veins of the wings are either parallel or diverging at the tip, never converging, while the anterior cross vein is never perpendicular to the fourth vein, meeting the discal cell at its distal third.

The bristles of the legs are constant in location, but not in number, and an apical spur is present on all the tibia.

The abdomen has five segments, and one or two genital segments. The chaetotaxy is not constant.

LIST OF ABBREVIATIONS.

ab.	Abdominal segment according to number.	mnt.	Metanotum.
acl.	Anal cell.	npl.	Notopleural bristles.
acr.	Acrostichal bristles.	npls.	Notopleural suture.
acrv.	Anterior cross vein.	o.	Ocelli.
ads.	Anterior dorsocentral bristles.	obr.	Ocellar bristles.
ala.	Alula.	ocf.	Occipital foramen.
an.	Antennal joints according to number.	om.	Oral margin.
anf.	Antennal fovea.	ot.	Ocellar triangle.
ans.	Anepisternum.	pal.	Post-alar bristles.
ao.	Anal opening.	pcl.	Posterior cell according to number.
ar.	Arista joints according to number.	pely.	Postalar callosity.
axcl.	Axillary cell.	perv.	Posterior cross-vein.
axv.	Auxiliary vein.	pd.	Prodorsum.
bcl.	Basal cell. according to number.	pds.	Posterior dorsocentral bristles.
bpl.	Basal plate.	phm.	Posthumeral bristles.
bsu.	Basal suture.	pls.	Pleural suture.
bu.	Bucca.	pns.	Penis.
c.	Cheek.	prc.	Paracephalon.
ca.	Anterior claspers.	pres.	Proepisternum.
cav.	Costa.	prf.	Parafrontal plates.
ccl.	Costal cell.	prnl.	Pronotal lobe.
clw.	Claw.	prs.	Praescutum.
cnd.	Condyles.	prsl.	Presutural bristles.
cp.	Posterior claspers.	prsu.	Paracephalic suture.
cx.	Coxa.	psn.	Prosternum.
dcl.	Discal cell.	ptg.	Pleurotergite.
c.	Compound eye.	ptp.	Pteropleurite.
emp.	Empodium.	pv.	Pulvillus.
ep.	Epistome.	pvbr.	Post-vertical bristles.
epc.	Epicephalon.	pwp.	Pleural wing processes.
epos.	Epioccipital sclerite.	rm.	Remigium.
ept.	Epaulet.	s.	Sella.
f.	Front.	sal.	Supra-alar bristles.
fc.	Forceps.	sapl.	Sub-alar plate.
fla.	Facialia.	sc.	Scutum.
fobr.	Fronto-orbital bristles.	scl.	Subcostal cell.
fsu.	Frontal suture.	sce.	Scape of the halter.
ft.	Frontal triangle.	scl.	Scutellum.
g.	Genæ.	scla.	Scutellar apical bristles.
gn.	Genital segment according to number.	scm.	Scabellum of the halter.
go.	Genital opening.	sept.	Subepaulet.
hcly.	Humeral callosity.	smcl.	Submarginal cell.
hd.	Head of halter.	so.	Sensory opening.
hr.	Halter.	sp.	Spiracle.
hm.	Humeral bristles.	spa.	Anterior thoracic spiracle.
ial.	Intra-alar bristles.	spp.	Posterior thoracic spiracle.
jscl.	Juxtascutellum.	sq.	Squama.
l.	Lunule.	sq.	Antisquama.
mcl.	Marginal cell.	sqd.	Squamoid scale of the halter.
mdtg.	Mediotergite.	ssu.	Sternopleural suture.
merp.	Meropleurite.	stp.	Sternopleurite.
mte.	Metacephalon.	stpbr.	Sternopleural bristles.
metm.	Meta-epimeron.	tpm.	Tympanic membrane.
mtes.	Meta-episternum.	v.	Longitudinal vein according to number.
		vbr.	Vibrissæ.
		vcbr.	Vertical cephalic bristles.

EXPLANATION OF PLATES.

PLATE XVII.

- Fig. 1. Anterior view of female head.
 Fig. 2. Anterior view of male head.
 Fig. 3. Lateral view of female head, right side.
 Fig. 4. Lateral view of male head, right side.
 Fig. 5. Face, a facial sclerite which bears the antennæ.
 Fig. 6. Antenna, showing joints and sensoria.
 Fig. 7. Posterior view of male head.
 Fig. 8. Antennal arista.

PLATE XVIII.

- Fig. 9. Dorsal view of thorax of male.
 Fig. 10. Anterior view of prothorax of male.
 Fig. 11. Halter.
 Fig. 12. Lateral view of male thorax, right side.

PLATE XIX.

- Fig. 13. Wing of male, right wing.
 Fig. 14. Epaulet, sub-epaulet, and base of the costa, of the right wing.
 Fig. 15. Remigium, of right wing of a male, showing chordonotal organs.
 Fig. 16. Left side of male to show squamæ.
 Fig. 17. Posterior spiracle of male.
 Fig. 18. Edge of squama.

PLATE XX.

(Legs taken from the right side of male.)

- Fig. 19. Metathoracic coxæ of male. A, Dorsal view. B, Anterior view.
 Fig. 20. Mesothoracic coxæ of male. Dorsal view.
 Fig. 21. Prothoracic coxæ of male. A, Dorsal view. B, Anterior view.
 Fig. 22. Anterior view metathoracic trochanter.
 Fig. 23. Mesothoracic trochanter. A, Anterior view. B, Dorsal.
 Fig. 24. Prothoracic trochanter. A, Posterior view. B, Ventral.
 Fig. 25. Metathoracic femur, dorsal view.
 Fig. 26. Mesothoracic tibia, anterior view.
 Fig. 27. Mesothoracic femur, dorsal view.
 Fig. 28. Prothoracic femur. A, Posterior view. B, Dorsal view.
 Fig. 29. Mesothoracic tibia, dorsal.
 Fig. 30. Anterior view of legs in position as described. A, Prothoracic, B, Mesothoracic. C, Metathoracic.
 Fig. 31. Prothoracic tibia, posterior view.

PLATE XXI.

- Fig. 32. Second genital segment and genitalia of the male.
 Fig. 33. Genitalia with genital segment and forceps removed.
 Fig. 34. Pulvilli. A, Male. B, Female.
 Fig. 35. Apex of last tarsal joint of male, posterior view.
 Fig. 36. Tarsus. A, Dorsal view of first joint, (outline). B, Posterior view of all tarsal joints. C, Dorsal view of last two tarsal joints. D, Union and articulation between first two tarsal joints. E, Edge of pulvillus showing roughened surface. F, Union and articulation of last two tarsal joints.

PLATE XXII.

- Fig. 37. Ventral view of male abdomen.
 Fig. 38. Dorsal view of male abdomen.
 Fig. 39. Section of abdominal wall to show flexibility of segments.
 Fig. 40. Ventral view of female abdomen.
 Fig. 41. Dorsal view of female abdomen.